# A Study of Sales Premium Using High-frequency Trading Data on Chinese Stock Exchanges

WANG, Yu

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Thesis/Assessment Committee

Prof. CHENG, Joseph Wui Wing (Chairman)
Prof. CHOW, Ying-Foon (Thesis Supervisor)
Prof. FONG, Wai Ming (Committee Member)
Prof. LIU, Ming (Committee Member)
Prof. WEI, Steven Xiangdong (External Examiner)

# Abstract

Sales premium is the premium order initiator pays in order to get the order executed when he is a seller instead of a buyer. This paper evaluates the sales premium by looking through the high-frequency data from both Shanghai Stock Exchange and Shenzhen Stock Exchange over the period from April 2007 to December 2008. By tracking 59 composite stocks from the two exchanges, positive sales premium is found in year 2007 and negative sales premium in year 2008.

The paper further examines the factors that affect sales premium. Sales premium is highly dependent to the market and the trading environment. Shanghai Stock Exchange requires a lower sales premium than Shenzhen Stock Exchange. Stock price and the market activity are both positively related to the sales premium, while market interest rate is negatively related to the premium in bullish market yet positively related to the premium in bearish market.

# 摘要

賣出溢價為交易發起方為賣家，而非買家時，發起方所需付出的溢價。本論文研究通過研究 2007 年 4 月至 2008 年 12 月期間，上海及深圳交易所之高頻交易數據來評估賣出溢價。數據樣本為 59 隻來自于上海證券交易所和深圳證券交易所的成份股。本研究觀察到 2007 年之高頻交易賣出溢價為正，而 2008 年之高頻交易賣出溢價為負。

本文進一步檢測了影響賣出溢價的因素。賣出溢價與市場狀況及交易環境息息相關。上海證券交易所所要求之賣出溢價低於深圳證券交易所。當股票價值升高，賣出溢價亦隨之升高。市場交易活躍度與賣出溢價成正比。利率在牛市與熊市對賣出溢價有不同影響。於牛市時，賣出溢價隨著利率的提升而提升；於熊市時，賣出溢價則隨著利率的降低而提升。

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# I. Introduction and Overview

On May 6th, 2010, the whole world observed how one single fat-finger trade triggered a 600 points plunge in Dow Jones Industrial Average, just to recover the losses within minutes. That is the "flash crash", or "the crash of 2:45", named by the mass media. This was the second largest point swing and the biggest one-day point decline in the index history. After 5 months' throughout investigation, the United States Securities and Exchange Commission (SEC) and the Commodity Futures Trade Commission (CFTC) jointly issued a report, implicating high-frequency traders liable for the event. Since then, high-frequency trading receives wide recognition from the general public and has been accused as a potential risk to a health financial market by the media. However, despite of the crash, both the industry[1] and the academic[2] believe that high-frequency trading has effectively increased the market liquidity, lowered the trading costs, increased the informativeness of quotes and brought positive spillover effects to a stable market.

Therefore, the effectiveness of high-frequency trading in the market as well as its transaction costs becomes an important issue for the future development of global equity market. High-frequency trading activities in

[1] Trade Worx, *SEC Letters* April 21, 2010 http://sec.gov/comments/s7-02-10/s70210-129.pdf
[2] Hendershott, Terrence, Charles M. Jones and Menkveld, Albert J., *Does Algorithmic Trading Improve Liquidity?* Journal of Finance, 2010

Chinese stock markets, from both Shanghai Stock Exchange and Shenzhen Stock Exchange, are gaining more and more attention. This study evaluates one component of the trading costs based high-frequency data in China and further assesses the factors that affect this component of the trading costs.

High-frequency trading involves both explicit costs and implicit costs. Explicit costs can be either fixed or variable. The exact amount of fixed costs, such as commission and fees, are known to traders when they place the order, prior to the execution. Meanwhile, variable costs cannot be confirmed until the deal is fully executed. The most common explicit variable costs are spreads and taxes. High frequency traders are important market drivers / makers. According to Wagner & Edwards (1993), approximately two-thirds of institutional orders are on average more than 50% of the stock's average daily trading volume and almost 40% of orders exceed 100% of the stock's average daily trading volume. Therefore, orders cannot be executed at prevailing price. Such orders inevitably affect the market prices adversely. There results in the implicit costs. None of the implicit costs are fixed. Here are the most important implicit costs.

- Timing costs. Different investment managers have different trading philosophy and risk appetites. Therefore, even though institutional

investors share a common target of best execution, it is not uncommon that they choose different execution schedules, which results in different timing costs.

- Opportunity costs. These arise when the initial order from investment managers failed to be fully executed. The forgone profits are deemed as opportunity costs.
- Price impact costs. Considering the large scale and high frequency the trades are, investors no longer purchase or sell stocks at the market prevailing rate. Instead they become a major drive of price movement, which can go along or against the desired direction.

Though all of these costs are related to market efficiency, timing costs and opportunity costs are mostly determined by the specific trading algorithm the institutional investors adopt. Our study focuses on the third variable implicit costs – price impact costs, the sales premium more precisely. Sales premium is the premium market requires for sell orders, that is, the premium order initiator pays when he is a seller than he is a buyer. The costs arise from the position of the deal initiator.

Extensive studies have been done about the price impact as well as factors

of block transactions, for example, Scholes (1972), Mikkelson and Partch (1985), Harris & Gurel (1986), Sheifer (1986), Loderer, Cooney, and Van Drunen (1991). These studies believe that three major factors that contribute to the price impact most.

1. Costs to attract additional market liquidity (selling-pressure hypothesis)

   Lower transaction costs work as the "sweetener" to attract additional buyers or sellers.

2. Costs of adverse selection (information effect hypothesis)

   Since the market participants are institutional investors of high-frequency trading. They are assumed to have more information than individual investors. The trade itself is a new piece of information to the market. Additional transaction costs are market's response to the new piece of information.

3. Costs due to lack of alternative investment options (substitution hypothesis)

   Assuming all securities in the market share similar characteristics and are merely the instrument to generate cash flows, for buy orders, investors have the chance to switch to another stock with similar characteristics if the prices for their initial holdings go beyond acceptable range. While on

the other hand for sell orders, investors have no other option but to pay for the costs due to lack of alternative investment options.

This study evaluates the transaction costs caused by different order positions through high-frequency data from Chinese stock markets. It is measured as the difference in transaction costs between orders that are initiated by buyers and orders that are initiated by sellers by quantifying sales premium, the premium initiator pays when he initiates a sell order than a buy order. Our study is based on previous studies on price impact as well as trading frictions. However, instead of focusing on the overall costs or specific frictions arose in trading, the only focus here is how the position of order initiator affects trading costs.

Section II reviews relevant literatures in market microstructure, costs measurements and trading frictions. Section III describes the data selection process and the statistic characteristics of sales premium in different subsample. Section IV assesses the factors that affect sales premium and section V carries out robustness tests. Section VI draws conclusion and points out the direction for further studies.

# II. Literature Review

Though there is not much literature discussing the trading costs for high-frequency trading specifically, there have been extensive studies of market microstructure that focus on market structure and transaction & timing costs, both of which provide theoretical and empirical knowledge about the trading costs of high-frequency trading.

Our study focuses on the part of the costs caused by different positions of deal initiators. Previous literature concerning the price impact set the theoretical foundation for our studies, while cost measurement literatures provide valuable insights for the measurements. Trading friction literatures provide us with a comprehensive list of potential factors for the sales premium.

## *1. Price Impact Literatures*

As mentioned in Section I, there are three alternative hypotheses concerning the causes of price impact – substitution hypothesis, selling-pressure hypothesis, and information effect hypothesis.

- Substitution hypothesis believes that all the securities in the markets have similar characteristics as an instrument to generate cash flows. Investors will switch to alternative investments once the price of their initial

holdings goes beyond acceptable zone.

- Selling-pressure hypothesis believes that securities markets are not perfectly elastic. All the price movements are caused by the temporary changes in market supply and demand. Block trading by itself brings no news to the market. Without other information, price should go back to previous level after the demand and supply rebalance through market mechanism, i.e., through market subsides or levies. Due to the imperfect elasticity nature of stock market, instead of switching to substitutes, market participants adjust their prices to retain their initial position and consequently rebalance the market supply and demand.
- Information effect hypothesis believes that block transaction itself is new piece of information to the market. Signal effect exists as the initiator's position differs. When a deal is initiated by seller, market participants typically expect bad news coming. When a deal is initiated by buyer, they expect the opposite. The significance of the news is measured by the size of the transaction. As a result, block size trading itself is new information with considerable significance.

Substitution hypothesis and selling-pressure hypothesis are competing

theory about stock elasticity. They have opposite assumptions whether perfect substitutes are always available in the market and whether investors can change their portfolio at ease (low costs). Substitution hypothesis assumes perfect elasticity while selling-pressure hypothesis pictures a downward slope demand curve.

Selling-pressure hypothesis and information effect hypothesis are competing theory about whether the trading activity of block transaction contains new information to the securities markets. Selling-pressure hypothesis assumes the trading itself contains no new information, while information effect hypothesis argues that markets always infer information from block trading activities.

Scholes (1972) tests the elasticity of securities markets using empirical data. Evidences support the substitution hypothesis, which means investors, both individual and institutional, consider securities or security portfolio as potential income streams with similar characteristics in general. It also presents the idea of information effect hypothesis and discusses it using secondary distribution data.

Mikkelson & Partch (1985) also studies the price effects of secondary distributions. Secondary distribution is the sale of a larger block of stock by

one shareholder to many smaller buyers. It has no cash flow implications for the firm, which makes it a better experiment than primary distribution. Mikkelson & Partch (1985) tests against all the three hypotheses. Significant adverse information effects are found, which supports the selling-pressure effect hypothesis. The information effect hypothesis is rejected as only temporary price reduction can be observed.

Similar to Mikelson & Partch (1985), Harris & Gurel (1986) finds short-term downward sloping demand curve only due to indexing. Once excess demand is met, the price impact vanishes.

In contrary to the last two papers, Sheifer (1986) finds both temporary and permanent price pressure effect for index changes. Loderer, Cooney, & Van Drunen (1991) controls for information effect and finds a long-term downward slope demand curve for new stock issuance. Wurgler & Zhuravskaya (2002) also recognizes permanent price pressure effect and significant lack of substitutability between various assets.

## *2. Cost Measurement Literatures*

Chan & Lakonishok (1993, 1995) investigated the price impact of a trade based on the trading records. By surveying from 37 institutional managers

over a 30-month' period, they found that the overall cost at the trade level from open-to-close is 0.34% for buy orders (a savings, negative sales premium) and -0.04% for sell orders (additional costs, positive sales premium). Chan & Lakonishok (1993) further estimates commission costs for institutional traders transacting in the largest decile of NYSE securities to be 0.13%. Combining these estimates with effective bid-ask spreads and commissions, the estimated one-way equity trading costs for institutional traders fall in the interval of (0.24%, 0.26%). Round-trip cost is 1.32% of the closing price 5 days after the order is completed.

Holthausen, Leftwich &Mayers (1987) finds the costs for sell orders are 0.40% while those of buy orders are only 0.33%. This means that sell orders have lower costs than buy orders, contradicting to the findings of Chan & Lakonishok (1993, 1995).

Beebower & Priest (1980) compares the execution price with closing price, and finds buy orders can be executed at a savings of 12 basis points, while sell orders need an additional 15 basis points for execution.

Chan & Lakonishok (1997) finds different exchanges are in favor of different types of transactions. It compares the transaction costs of NYSE and NASDAQ and observes lower costs for small cap orders in NASDAQ, while

large cap orders enjoy discounts in their trading costs in NYSE.

## 3. *Trading Friction Literatures*

Stoll (2002) distinguishes total friction from its components, that is, real friction and informational friction. Real frictions arise from order processing as well as inventory holding. They use up real resources. Informational frictions, on the other hand, redistribute wealth. Stoll (2002) uses both static measures and dynamic measures to assess the frictions. It introduces the concepts of quotes spread, effective spread as well as traded spread and implied spread. Evidences are found that stocks with higher effective / quoted spread tend to have higher traded/Roll implied spread. Inventory effects have negative serial covariance in quotes. Real frictions and information frictions share similar company characteristics, despite the fact that they have distinguished reasons and are the results of different mechanisms.

Stoll (2002) also looks into the relationship between market and frictions. Opening friction does not depend on the trading characteristics of specific stocks. Opening volatility is commonly observed, yet it is caused by overnight news and the market timing, rather than the characteristics of individual stocks. Different stock exchanges have different scales of frictions. Stock

traded in NASDAQ, for example, has a larger real friction than its peers in NYSE, after controlling company characteristics.

# III. Sample Description

## *1. Data Source*

Trading data are obtained from TAQ High-Frequency Database by GTA (國泰安), which provides a complete record of high-frequency trades in Chinese markets in chronological order. The database provides the best 5 asks and bids as well as the position of order initiator for each transaction. Therefore, instead of following the conventional way of inferring initiator's position by execution price, our study has a more straightforward way to obtain the accurate position of the parties involved in the trades. Due to the heavy trading nature of high-frequency trading and data availability, the study covers the trading activities from April 2007 to December 2008 in two major Chinese stock exchanges, Shanghai Stock Exchange (SHEX) and Shenzhen Stock Exchange (SZEX).

Market information, including market turnover, interest rate, composite movements, is obtained from Bloomberg. Considering the nature of professionalism in trading and ability and ease to access capital market for the algorithm trading from institutional investors, 1-week Shanghai intra-bank interest rate is used as the proxy for interest rate.

## 2. *Selection Criteria for Sample Stocks*

The data are sampled according to the following criteria:

1. Composition stocks from either Shanghai and Shenzhen Stock Exchange
2. In order to avoid survivorship bias, only stocks that are in the composite for the entire 21 months are considered.
3. In order to protect the integrity of the data and to eliminate the costs caused by insufficient market trading, we focus on the stocks that have been actively traded only. All the selected stocks had successive 21 months' trading records.
4. Entries that fail to indicate the position of initiator (i.e., seller-initiated or buyer-initiated) are dropped from the sample.
5. Only successful trades are included in the sample. Orders that failed to be executed, i.e., quotes only without successful execution, are dropped from the sample.

We then have 60 stocks' trading data over the 21 months span, half of which are from Shanghai Stock Exchange with the remaining from Shenzhen Stock Exchange.

Absolute costs of trading are calculated using the formula below.

$$\text{Cost} = \begin{cases} \text{Best Bid Price} - \text{Execution Price}, & \text{seller - initiated deals} \\ \text{Execution Price} - \text{Best Ask Price}, & \text{buyer - initiated deals} \end{cases} \quad (1)$$

Relative costs are calculated as the percentage of absolute costs out of execution price.

## 3. *Summary of Statistics*

### i. General Description

The average absolute costs and relative cost of all the 60 stocks over the 21 months' period are plotted in Graph 1 & Graph 2.

——— Insert Graph 1 and Graph 2 Here ———

It is obvious that one of the 60 stocks demonstrates a very different cost pattern from the others, that is, SZ 002007 Hualan Biological Engineering, Inc. The stock has an absolute cost of ¥1.7733 and a relative cost of 4.6622% per transaction, both of which are significantly higher than the rest of the sample. The high transaction costs are most likely raised from the illiquidity of Hualan Biological Engineering. Over 21 months' period, only 166,823 transactions have been successfully executed, which is the lowest among all the 60 stocks. It is less than 20% of the average number of transactions and around one-third of that of the stock that has the second lowest number of transactions over the same period. In order to compensate the illiquidity, investment managers need to pay a premium when purchasing and accept a

discount when selling.

Due to the very same reason we focus on composite stocks only, SZ 000027 Hualan Biological Engineering, Inc. is dropped from the sample, which leaves us with 59 stocks' data from April 2007 to December 2008.

The absolute costs per transaction in the new sample is under ¥ 1.00, with the relative costs between 0.2% to 1.4% of stock's execution price (Graph 3 & Graph 4).

——— Insert Graph 3 and Graph 4 Here ———

## ii. Shanghai Stock Exchange versus Shenzhen Stock Exchange

There are stocks from both Shanghai Stock Exchange (SHEX) and Shenzhen Stock Exchange (SZEX) in our sample. As summarized in Table 1, SHEX have lower absolute costs, yet a higher relative costs than SZEX. Both markets have extensive high-frequency trading activities, but SHEX has 25.7% more trades than SZEX does in our sample period.

——— Insert Table 1 Here ———

The transaction costs appear to be unexpectedly high. The average relative costs are as high as 0.6%. This may be caused by the

individual-dominated feature of Chinese stock market. Unlike most of both developed and developing markets whose major players are institutional investors, Chinese stock market are under vigorous restrictions and dominated by individual investors. The average order size is significantly smaller than that in other markets, like U.S. or European stock markets, and their asks and bids tend to be more diverged from market prevailing rates. This may be the major cause of such high costs and we expect the cost level to drop with more and more high-frequency trades in the future.

### iii. Normality Test

Our study uses relative costs as the proxy for trading costs, since it is the most commonly used measurement of trading costs in literature. General normality plot is drawn to check sample distribution. According to Graph 5, relative costs are well fitted for normal distribution.

——— Insert Graph 5 Here ———

Formal normality tests are also performed, and the null hypotheses cannot be rejected at 5% level by any of the major normality tests.

- Doornik-Hansen test = 10.5994, with p-value ≈ 0.0049932
- Shapiro-Wilk W = 0.938996, with p-value ≈ 0.00534893

- Lilliefors test = 0.117496, with p-value ≈ 0.04
- Jarque-Bera test = 10.3949, with p-value ≈ 0.00553065

Henceforth the relative costs of high-frequency trading in Chinese stock markets are assumed to follow normal distribution.

# IV. Regression Analysis

## 1. *Sales Premium Estimation*

Sales premium is the premium order initiators needs to pay when they are seller instead of buyer, with all the other factors controlled. That is,

$$Sales\ premium = Initiator's\ Costs_{seller\text{-}initiated} - Initiator's\ Costs_{buyer\text{-}initiated} \quad (2)$$

Taken the relevant independent variables that are related to transaction costs into consideration, we come to the estimation model below.

$$RCost_{i,m,t} = \beta_{0,i,m} + \beta_{1,i,m} BSDummy_{i,m,t} + \beta_{2,i,m} Early_{i,m,t} + \beta_{3,i,m} TS_{i,m,t} + \beta_{4,i,m} Top5Wgt_{i,m,t} + \beta_{5,i,m} BSRatio_{i,m,t} + \varepsilon_{i,m} \quad (3)$$

where

- *RCost*: Relative cost of the deal, i.e., *RCost = Cost / Execution Cost*, where

$$\text{Cost} = \begin{cases} \text{Best Bid Price} - \text{Execution Price}, & \text{Seller-initiated Deals} \\ \text{Execution Price} - \text{Best Ask Price}, & \text{Buyer-initiated Deals} \end{cases} \quad (4)$$

- *BSDummy*: Dummy variable indicating the position of deal initiator. One for buyer initiated transactions, and zero for seller initiated deals.
- *Early*: Dummy variable to indicate whether transactions were executed in the first hour of trading day, i.e., traded before 10:00 am.
- *TS*: Accumulated trading volume of the stock from the official opening to the time the deal was executed.
- *Top5Wgt*: Measurement of market liquidity. The weight of total volume

of the best 5 ask offers and the best 5 bid offers taken in its accumulated trading volume

- *BSRatio*: Buying ratio, i.e.,

$$BSRatio = \frac{\text{Trading volume based on the best ask price}}{\text{Accumulated trading volume}} \qquad (5)$$

The estimated coefficient of Buy/Sell Dummy $\beta_{1,i,m}$ is the sales premium. Positive sales premium means sellers need to pay a premium (additional costs) to execute the order, while negative sales premium means sellers can enjoy a discount (a savings in costs) when executing the order.

Regression is run for all the 59 stocks on monthly basis. This gives us a panel estimation of 59 stocks' sales premium over 21 months.

## 2. *Statistics of the Estimated Sales Premium*

A summary of estimated sales premium is reported in Table 2. It should be noted that 81.89% of the sales premium estimated is statistically significant at 1% level, 84.56% at 5% level and 86.74% at 10% level.

Except for the first 2 months' data of SH 600029 China Southern Airlines Limited, estimated premium falls in the interval of (-6, 5). Since there is only one day in both April and May 2007 when SH 600029 had trades executed successfully, the estimators could be biased and are dropped off from the

sample.

The statistics of the new sample are summarized in Table 3. From the frequency distribution shown in Graph 6, we can see that the sales premium is bell-shaped with slight negative skewness.

——— Insert Graph 6 and Table 3 Here ———

Graph 7 & Graph 8 are the plots for the sales premium in Shanghai Stock Exchange and Shenzhen Stock Exchange respectively. As can be seen from Graph 7 & Graph 8, the distributions of the premium are similar, though Shenzhen Stock Exchange has more outliers than Shanghai Stock Exchange.

——— Insert Graph 7 and Graph 8 Here ———

Sales premium appears to distribute evenly around zero in the sample. When testing the full sample, we cannot reject the hypothesis that the sales premium is no different from to zero. There is no significant difference between the trading costs of seller-initiated orders and those of buyer-initiated orders. However, when testing 2007 and 2008 subsamples separately (Table 4), there is a significant positive sales premium in year 2007 and a significant negative sales premium in year 2008. This suggests that sell orders were more expensive to be executed than the buy orders in 2007, but cheaper in 2008.

—— Insert Table 4 Here ——

## 3. *Factors that Impact the Sales Premium*

### i. Panel Data Regression

In the following, we run the panel data regression of the form:

$$SP_{i,m} = \beta_0 + \beta_1 Mkt_{i,m} + \beta_2 MktVol_{i,m} + \beta_3 Interest_m + \beta_4 Time_{i,m} + \beta_5 SHEX_i + \beta_6 Vol_{i,m} + \beta_7 Stock_{i,m} + \varepsilon_{i,m} \quad (6)$$

where

- *SP*: Sales premium of stock i in month m. SP is equal to $\beta_{1,i,m}$ in equation (3), that is, the coefficient of Buy/Sell Dummy.
- *Mkt*: The market index of the stock exchange the stock is listed on, i.e., Shanghai / Shenzhen Stock Exchange Composite Index.
- *MktVol*: Accumulated monthly trading volume of entire Shanghai / Shenzhen Stock Exchange
- *Interest*: 1-week Shanghai inter-bank offered rate
- *Time*: Monthly indicator for the time
- *SHEX*: Dummy indicating the listing exchange. One if the stock is listed in Shanghai Stock Exchange, zero if the stock is listed in the Shenzhen Stock Exchange

- *Vol*: Accumulated monthly trading volume of the stock.
- *Stock*: Stock Price is measured as the average of the close price of first and last trading day of the month.

## ii. Results and Interpretations

Considering the opposite sign of sales premium in year 2007 and 2008, we run separate tests for both years as well as the full sample. Both random effect model and fixed effect model are tested. (Table 5) All the t statistics reported are Newey West t statistics for robustness.

——— Insert Table 5 Here ———

Though the level of significance differs in the regression results of three subsamples, their estimated coefficients are similar in all the regressions and the coefficients always share the same sign.

Positive coefficients for market index and market volume imply that higher sales premium is in order for seller-initiated transactions when market is bullish and has active trading activities.

Interest rate is negatively related to sales premium in bullish market, which implies that the higher interest rate, the less sales premium seller-initiated transactions have to pay. Higher interest rate means higher

required rate of return to invest in the stock market. Institutional investors have more flexibility than individual investors and can switch their investment portfolio/plan at lower costs. By decreasing sales premium, outside investors are induced to the high-frequency market. Sales premium here works as the "sweetener" in Scholes (1972). When market is bearish, interest rate is positively related to sales premium. Institutional investors who used to trade in high-frequency equity market are motivated to leave for less volatile alternatives. Higher sales premium works as a "bitter", making it more costly for investors to leave, and consequently retains the investors.

Stocks in Shanghai Stock Exchange have lower sales premium than the stocks in Shenzhen. Higher stock price results in higher sales premium. With higher stock price, investors' opportunity costs from unsuccessful orders also increase. Therefore, in order to reduce number of deals that fail to be fully executed finally, sellers are willing to pay more costs to assure the deals are fully executed.

There is no significant time drift in the sales premium and its relationship with stock trading volume is also inconclusive.

### iii. Sales Premium versus Economic Events

In order to study why year 2007 and 2008 have different sales premium pattern, time dummies are added to the random effect model. (Table 6)

——— Insert Table 6 Here ———

All sharp drops are statistically significant at 1% level and coincidence with the major events of subprime crisis.

Timeline of major events in subprime (April 2007 – December 2008)

- *June 2007*: Collapse of two Bear Stearns' hedge funds due to losses in subprime market.
- *January 2008*: Stock market started to melt down. National Association of Realtors (NAR) announced that 2007 had the largest drop in existing home sales in 25 years, and predicted a chance for a second Great Depression.
- *March 2008*: Bear Stearns was acquired by JPMorgan at $2 per share.
- *June 2008*: Housing bailout plan was presented to the Senate.
- *September 2008*: Merrill Lynch was sold to Bank of America. Lehman Brother filled bankruptcy. Fannie Mae & Freddie Mac get nationalized.
- *October 2008*: Emergency Economic Stabilization Act got passed by U.S. Senate. A $700 billion Trouble Asset Relief Program launched as a bailout

plan to purchase failing bank assets. The financial crisis spread to Europe.

The high similarity between the timeline of subprime events and the timeline of significant negative time dummies suggests that subprime crisis can be the main reason why the market requires a premium for seller-initiated orders in 2007 while offering a discount for similar transactions one year later. Despite of the vigorous restrictions that Chinese government imposes on both overseas capitals which would like to invest in China and Chinese capital that would like to invest in overseas markets, the professionalism and complexity nature of high-frequency trading means that the participants are more sensitive to global economic events than the general Chinese stock market. When the subprime crisis evolved from a problem of U.S real estate market to the problem of entire U.S. financial industry, made significant influences in European markets, and later became a global event, Chinese high-frequency markets could no longer stand aside.

# IV. Robustness Tests

In order to generate a robust result, all the regressions use Newey West t-statisticse. Nevertheless, common robustness tests are performed to address the concerns. Additional estimation of sales premium is done in Shenzhen Stock Exchange so as to test the robustness of sales premium estimation.

## *1. Common Robustness Tests*

Four robustness tests are done with results reported in Table 7.

——— Insert Table 7 Here ———

### i. Validity of Fixed-Effect Model

In the tests for differing group intercepts, the results for the 2008 sample and the full sample cannot rejected that the group have a common intercept. Yet that of the 2007 sample reject the null hypothesis at 1% of significance. In this case, random effect model is the preferred model.

### ii. Autocorrelation Problem: Durbin-Watson tests

Results from Durbin-Waston tests cannot reject the independent error hypothesis for any of the three subsamples, that is, sample of 2007, sample of 2008 and the full 21 months' sample. Therefore, there is no autocorrelation problem.

### iii. Heteroskedasticity

Breusch-Pagan test is performed for all the random effect model regressions in Section III. There is no sign of heteroskedasticity for 2008 sample and the full sample, yet we cannot reject the null hypothesis at 5% level for 2007 sample.

### iv. Consistency of Estimators

Results from Hausman test cannot reject the null hypothesis for all the three samples. Estimators are consistent.

### v. Multicollinearity

As some of the factors we have in equation (6) are highly correlated, such as Mkt and MktVol. There is concern about multicollinearity problem that can lead to biased estimation. Regressions are repeated with only Mkt factor and with only MktVol. Similar results are generated for the full sample and 2008 sample. Yet signal reversal is observed for 2007 sample.

The regression results for 2008 sample and full sample are robust. The estimators for 2007 sample are consistent, but can be subject to heteroskedasticity and multicollinearity problems.

## 2. *Additional Variable for Sales Premium Estimation in Shenzhen Stock Exchange*

The robustness of the estimation of sales premium is also tested. Since Shenzhen Stock Exchange provides number of deals traded for the specific transaction, we include this additional control variable in the estimation of sales premium. The new model is

$$RCost_{i,m,t} = \beta_{0,i,m} + \beta_{1,i,m} BSDummy_{i,m,t} + \beta_{2,i,m} Early_{i,m,t} + \beta_{3,i,m} TS_{i,m,t} + \beta_{4,i,m} Top5Wgt_{i,m,t} + \beta_{5,i,m} BSRatio_{i,m,t} + \beta_{6,i,m} Deal_{i,m,t} + \varepsilon_{i,m} \quad (7)$$

We obtain very similar results from the new model. Positive sales premium in 2007 and negative sales premium in 2008 imply that sell orders are more expensive to be executed than buy orders in 2007 and cheaper in 2008.

# V. Conclusion

This study evaluates the sales premium caused by different positions of the order initiators based on high-frequency data from Chinese stock markets. Sales premium is the additional costs the initiators need to pay in order to get the order executed when they are seller instead of buyer. It is related to, but different from the trading friction concepts that have been studies in previous literatures. In friction studies, real frictions typically are caused by order processing costs and inventory costs, while informational frictions are about the price impact. They are largely determined by the stock characteristics. Sales premium, though closely related to price impact and dependent to the individual characteristics, is closely related to the trading environment and market situations.

By analyzing 21 months' trading data of 59 composite stocks from both Shanghai and Shenzhen Stock Exchanges, positive sales premium is observed in year 2007, while negative sales premium dominated year 2008. This suggests that comparing with buyer-initiated orders, seller-initiated orders had positive sales premium (additional trading costs) in 2007 and enjoyed negative sales premium (savings) in trading costs in 2008.

Sales premium is mostly determined by the market and economic

environments. Shanghai Stock Exchange demands a lower sales premium than Shenzhen stock market, and an actively traded market asks for larger sales premium. It is in a negative relationship to interest rate in bullish market and in a positive relationship in bearish market.

Besides the market and economic environments, sales premium of one stock is also subject to its own stock price. The higher the price is the larger opportunity costs for unsuccessful orders, consequently higher sales premium in order to secure successful execution.

There is no inconclusive result whether there exists a time drift for sales premium. In a stable market, lower sales premium implies the market is more efficient. Henceforth, negative time drift suggests the equity market, in general, is becoming more and more efficient. However, because the sample period we have is from April 2007 and December 2008, when the market went through the subprime crisis, it was under huge pressure and uncertainty, which results in high volatility. Investors were very sensitive to the market movements over the sample period, and sales premium may not be a good indicator of market efficiency.

The regressions are robust in our 2008 subsample and the full sample. However, 2007 sample is subject to heteroskedasticity and multicollinearity

problems. Further studies should choose try to tackle the problems or avoid choosing 2007 sample.

Due to the special and fragile investment environments over the sample period, further studies should also consider using a longer sample period with no major economic shocks. With a stable market, we should be able get a more generalized idea how macro and micro factors affect the sales premium and its long-term trends and quantify the impacts of different factors.

# Bibliography


1. Ajinkya, Bipin B. & Jain, Prem C., 1989. "The behavior of daily stock market trading volume," *Journal of Accounting and Economics*, Elsevier, vol. 11(4), pages 331-359, November.

2. Amihud, Yakov & Mendelson, Haim, 1986. "Asset pricing and the bid-ask spread," *Journal of Financial Economics*, Elsevier, vol. 17(2), pages 223-249, December.

3. Beebower, Gilbert L. & Priest, William, 1980. "The Tricks of The Trade,", *Journal of Portfolio Management* 6(2), pages 36-42, Winter.

4. Bubbel, David F., Craig B. Merrill, Mark F. Meyer & Meiring de Villiers, 2001, "The Effect of Transaction Size on Off-the-Run Treasury Prices", *Working Paper, Wharton Financial Institutions Center*, February.

5. Chan, Louis K. C. & Lakonishok, Josef, 1993. "Institutional trades and intraday stock price behavior," *Journal of Financial Economics*, Elsevier, vol. 33(2), pages 173-199, April.

6. Chan, Louis K C & Lakonishok, Josef, 1995." The Behavior of Stock Prices around Institutional Trades," *Journal of Finance*, American Finance Association, vol. 50(4), pages 1147-74, September.

7. Edelen, Roger M. and Warner, Jerold B., (2001), "Aggregate price effects of institutional trading: a study of mutual fund flow and market returns," *Journal of Financial Economics*, 59, issue 2, p. 195-220.

8. Edelen, Roger M., 1999."Investor flows and the assessed performance of open-end mutual funds," *Journal of Financial Economics,* Elsevier, vol. 53(3), pages 439-466, September.

9. Frino, Alex, Lepone, Andrew & Jarnecic, Elvis, 2007. "The Determinants of the Price Impact of Block Trades: Further Evidence, "*Abacus*, Vol. 43(1), pages 94-106, March.

10. Harris, Lawrence E & Gurel, Eitan, 1986."Price and Volume Effects Associated with Changes in the S&P 500 List: New Evidence for the Existence of Price

Pressures," *Journal of Finance*, American Finance Association, vol. 41(4), pages 815-29, September.

11. Hendershott, Terrence, Charles M. Jones & Menkveld, Albert J., 2010. "Does Algorithmic Trading Improve Liquidity?" *Journal of Finance,* vol. 66(1), pages 1-33, August.

12. Holthausen, Robert W. & Leftwich, Richard W. & Mayers, David, 1987. "The Effect of Large Block Transactions On Security Prices: A Cross-sectional Analysis," *Journal of Financial Economics*, Elsevier, vol. 19(2), pages 237-267, December.

13. Holthausen, Robert W. & Leftwich, Richard W. & Mayers, David, 1990. "Large-block Transactions, the Speed of Response, and Temporary and Permanent Stock-price Effects," *Journal of Financial Economics*, Elsevier, vol. 26(1), pages 71-95, July.

14. Huang, Roger D & Stoll, Hans R, 1997. "The Components of the Bid-Ask Spread: A General Approach," *Review of Financial Studies*, Oxford University Press for Society for Financial Studies, vol. 10(4), pages 995-1034.

15. Huang, Roger D. & Stoll, Hans R., 1996."Dealer versus auction markets: A paired comparison of execution costs on NASDAQ and the NYSE," *Journal of Financial Economics*, Elsevier, vol. 41(3), pages 313-357, July.

16. ITG Inc., 2005. "Implementation Shortfall – One Objective, Many Algorithms".

17. Kraus, Alan & Stoll, Hans R, 1972. "Price Impacts of Block Trading on the New York Stock Exchange," *Journal of Finance*, American Finance Association, vol. 27(3), pages 569-88, June.

18. Lynch, Anthony W & Mendenhall, Richard R, 1997. "New Evidence on Stock Price Effects Associated with Changes in the S&P 500 Index," *Journal of Business*, University of Chicago Press, vol. 70(3), pages 351-83, July.

19. Loderer, Claudio & Cooney, John W & van Drunen, Leonard D, 1991. "The Price Elasticity of Demand for Common Stock," *Journal of Finance*, American Finance Association, vol. 46(2), pages 621-51, June.

20. Mikkelson, Wayne H. & Partch, M. Megan, 1985. "Stock price effects and costs of secondary distributions," *Journal of Financial Economics*, Elsevier, vol. 14(2), pages 165-194, June.

21. Perold, André F, 1988. "The Implementation Shortfall: Paper vs. Reality", *Journal of Portfolio Management* 14(3), pages 4-9, Spring.

22. Scholes, Myron S, 1972. "The Market for Securities: Substitution versus Price Pressure and the Effects of Information on Share Prices," *Journal of Business, University of Chicago Press*, vol. 45(2), pages 179-211, April.

23. Shleifer, Andrei, 1986. "Do Demand Curves for Stocks Slope Down?" *Journal of Finance*, American Finance Association, vol. 41(3), pages 579-90, July.

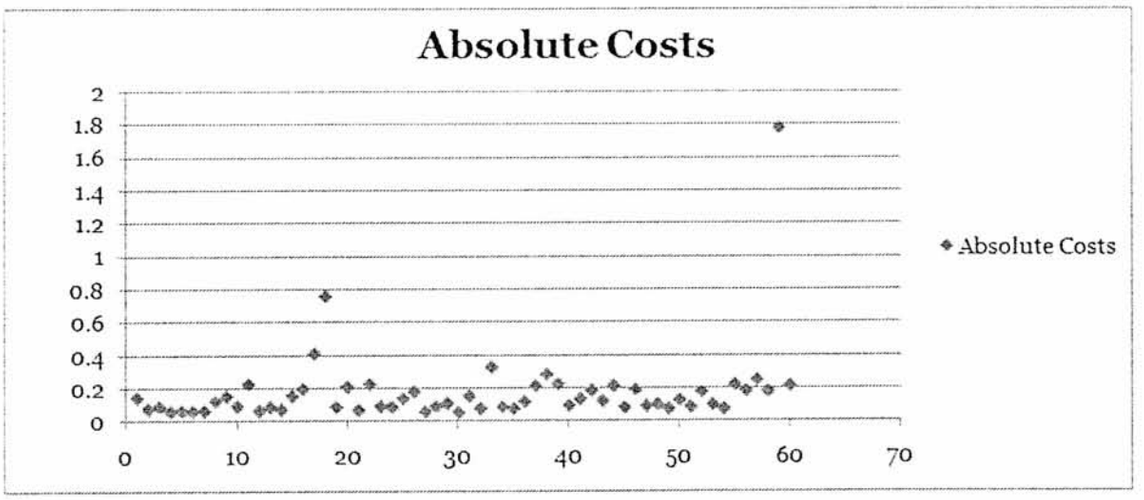
24. Stoll, Hans R., 2000. "Presidential Address: Friction," *Journal of Finance*, American Finance Association, vol. 55(4), pages 1479-1514, 08.

25. Wayne H. Wagner & Mark Edwards, 1993. "Best Execution," *Financial Analysts Journal*, Vol. 49(1) pages 65-71, Februray.

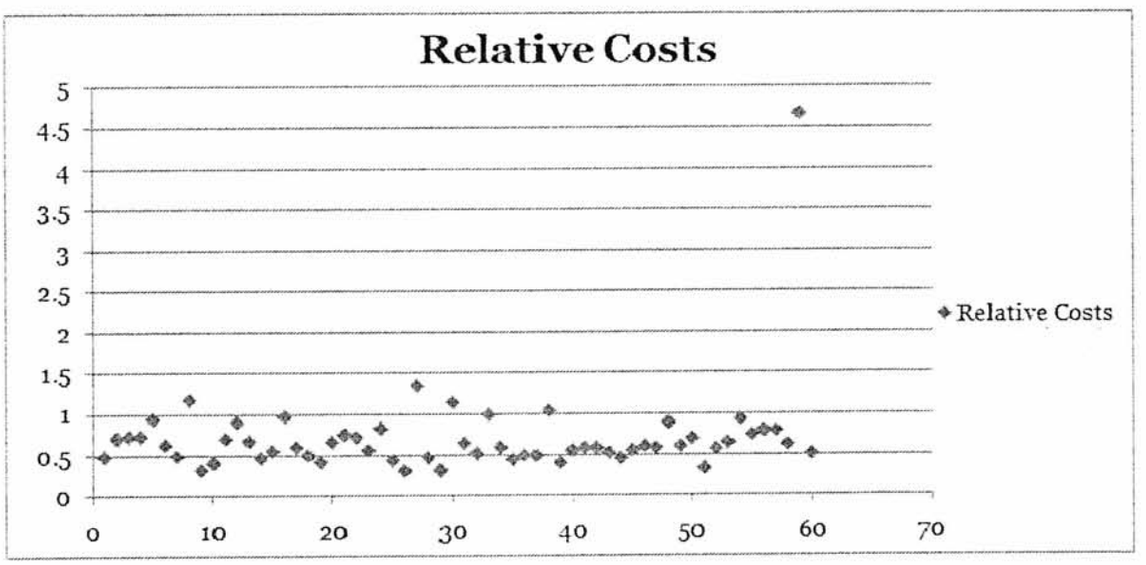
26. Jeffrey Wurgler & Ekaterina Zhuravskaya, 2000."Does Arbitrage Flatten Demand Curves for Stocks?," Yale School of Management Working Papers, Yale School of Management, revised 01 Nov 2001

# Appendix A. Graphs

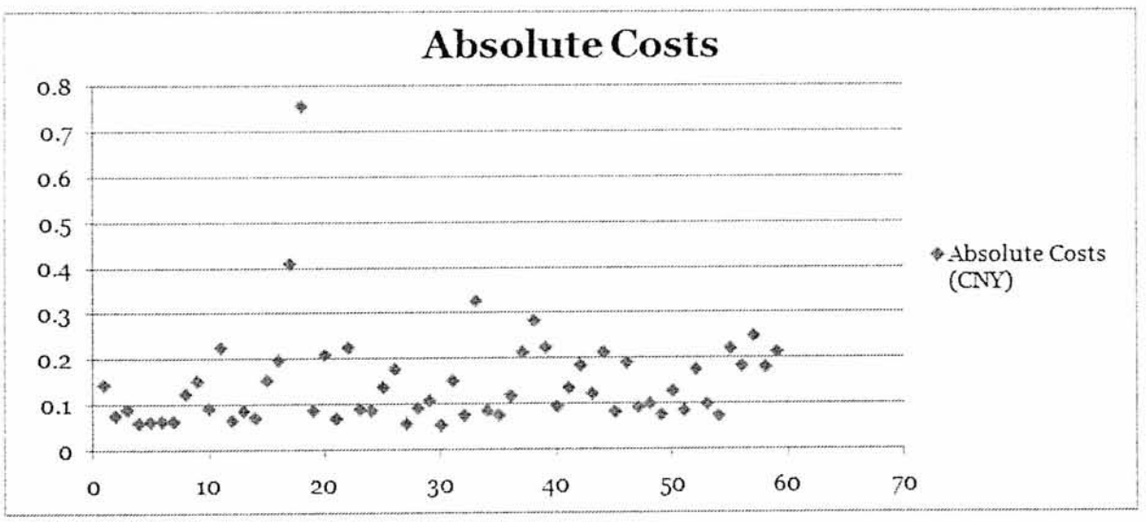
## Graph 1. Absolute Costs of 60-stock Sample



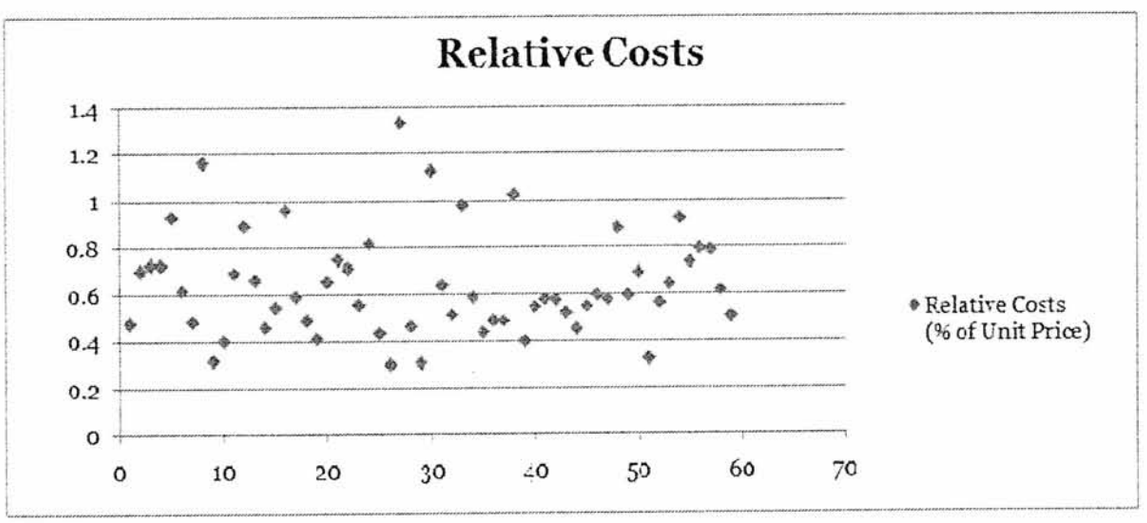

## Graph 2. Relative Costs of 60-stock Sample



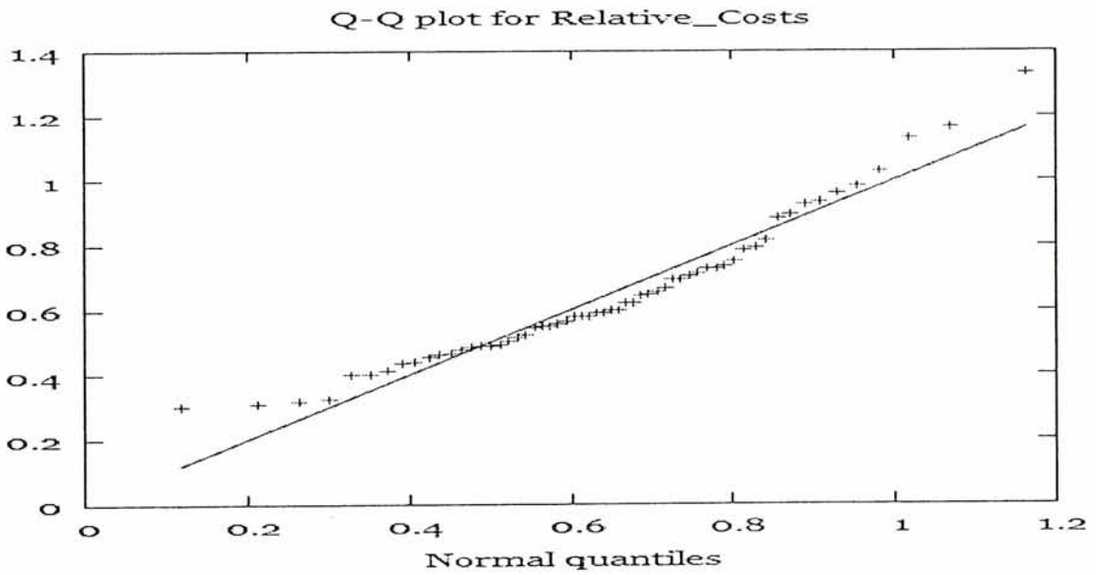
**Graph 3. Absolute Costs of 59-stock Sample**



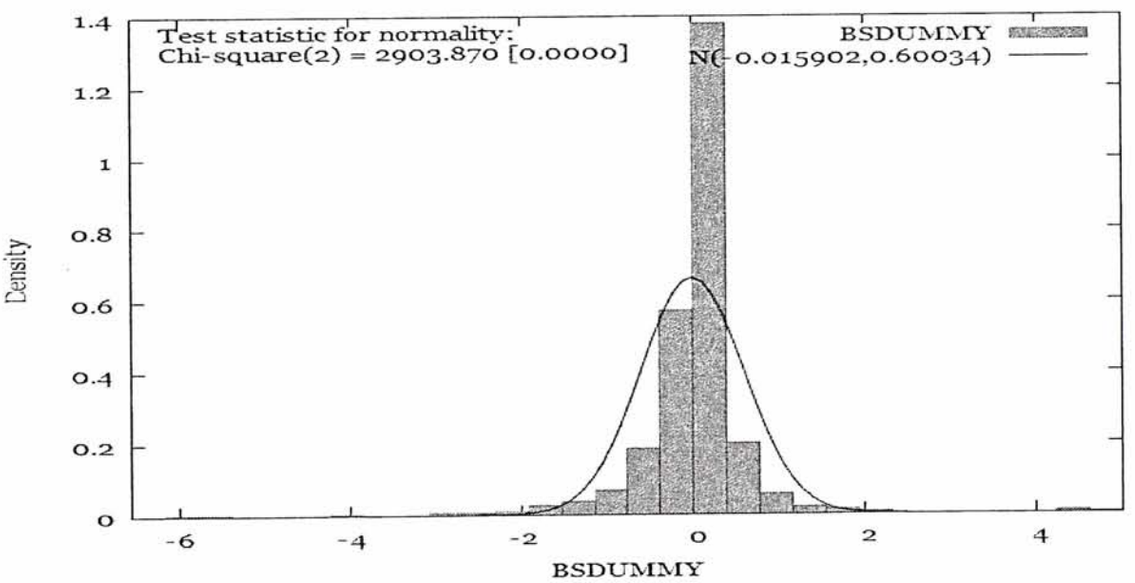

**Graph 4. Relative Costs of 59-stock Sample**



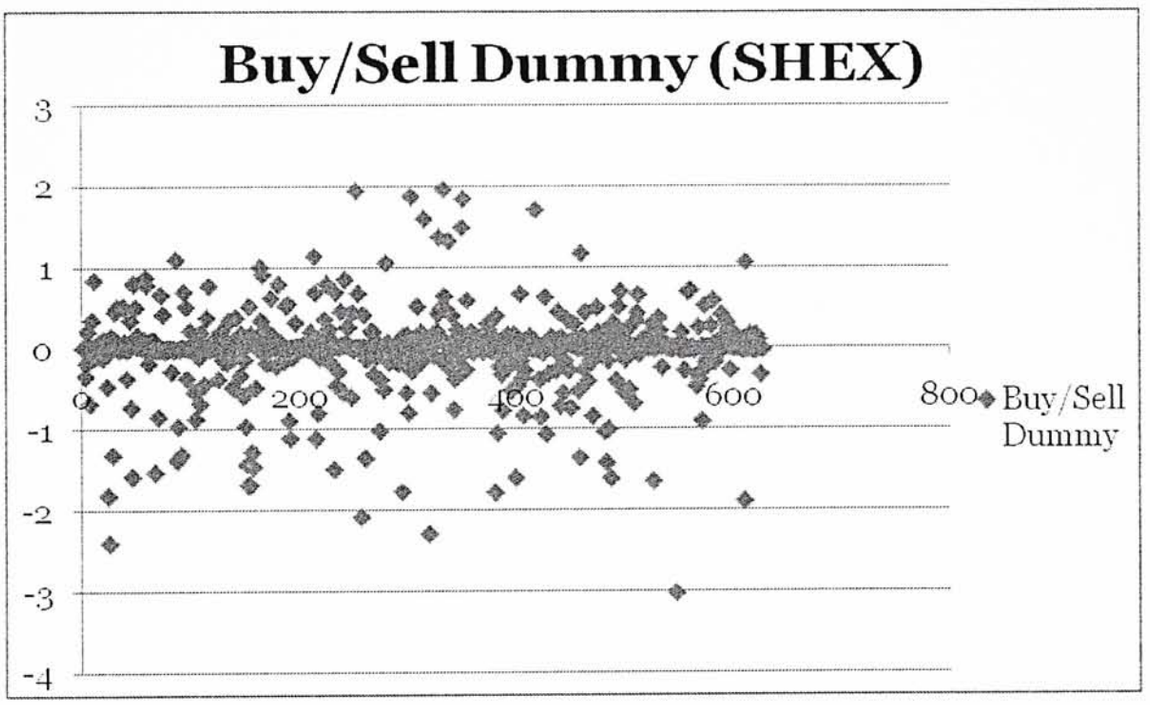
## Graph 5. Normality Test For Relative Costs



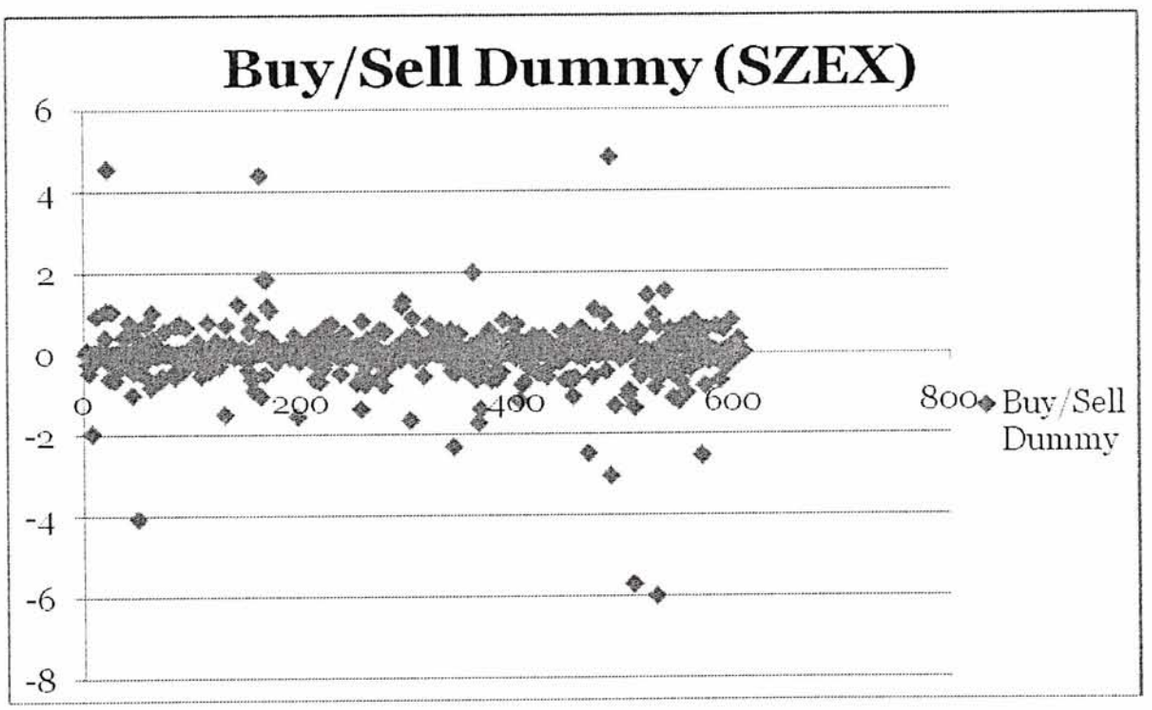

## Graph 6. Frequency Distribution of Sales Premium



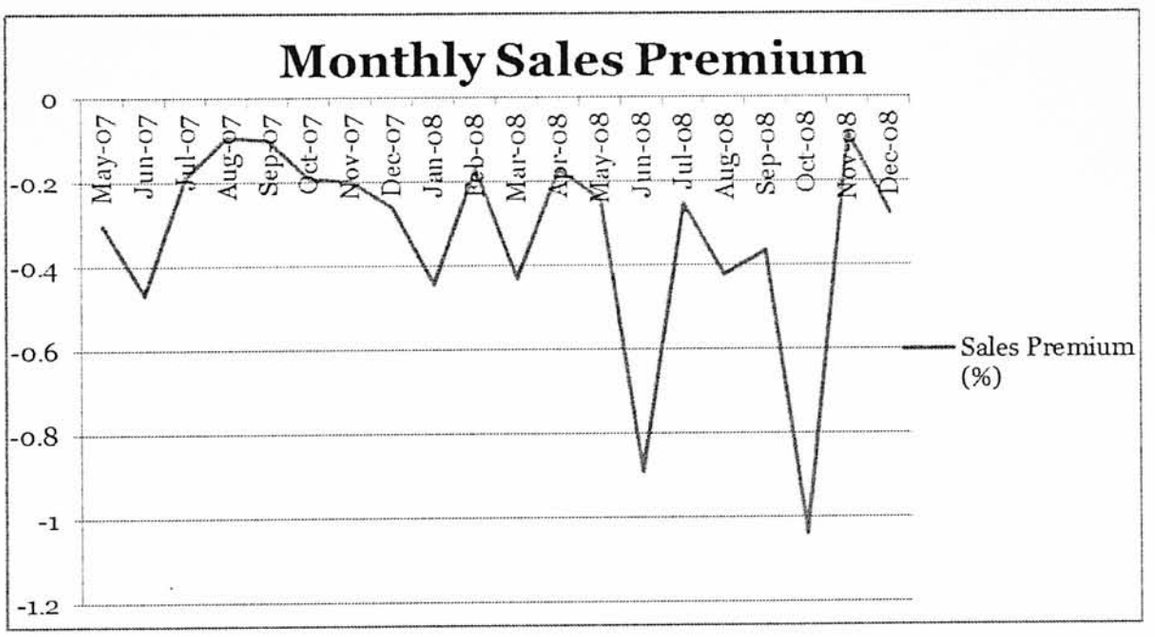
**Graph 7. Sales Premium of SHEX**




**Graph 8. Sales Premium of SZEX**



**Graph 9. Monthly Sales Premium Estimation**



# Appendix B. Tables

### Table 1. Summary of Costs in Shanghai/Shenzhen Stock Exchanges

The sample includes 60 composite stocks' trading data, among which 30 are from Shenzhen Stock Exchange and 30 are from Shanghai Stock Exchange. The sample covers a period of 21 months from April 2007 to December 2008.

| | | SHEX | SZEX |
|---|---|---|---|
| **Total Number of Transactions** | | 28,859,364 | 22,957,299 |
| **Absolute Costs (¥)** | Mean | 0.1279 | 0.1550 |
| | Median | 0.0901 | 0.1432 |
| **Relative Costs (%)** | Mean | 0.6610 | 0.6388 |
| | Median | 0.6386 | 0.5858 |

### Table 2. Statistics Summary of Sales Premium (Complete Sample)

The complete sample includes 59 composite stocks' trading data, among which 29 are from Shenzhen Stock Exchange and 30 are from Shanghai Stock Exchange. The sample covers a period of 21 months from April 2007 to December 2008.

| Mean | Median | Min | Max | Std Dev | Skewness |
|---|---|---|---|---|---|
| 0.05765 | 0.0146 | -5.9758 | 66.536 | 2.1024 | 26.79 |

**Table 3. Statistics Summary of Sales Premium (Excluding Outliers)**

The full sample here, which is the final sample pool for all the regressions later include the same 59 composite stocks as the complete sample does, but April and May 2007 data of SH600029 China Southern Airline Limited is dropped due to insufficient trades.

| | Mean | Median | Min | Max | Std Dev | Skewness |
|---|---|---|---|---|---|---|
| **Full Sample** | -0.016 | 0.0145 | -5.976 | 4.8176 | 0.6003 | -1.204 |
| **SHEX** | -0.029 | 0.0099 | -3.024 | 1.9628 | 0.5045 | -1.047 |
| **SZEX** | -0.003 | 0.0200 | -5.976 | 4.8176 | 0.6855 | -1.241 |

**Table 4. Summary of Sales Premium Estimation**

The test whether the sales premium is positive / negative in year 2007 / 2008 resepectively uses the full sample, that is, all the 59 stocks from both Shanghai and Shenzhen Stock Exchanges are included.

| | Year | |
|---|---|---|
| | **2007** | **2008** |
| **Sample Size** | 529 | 708 |
| **Sample Mean** | 0.1052 | -0.1064 |
| **Std. Dev** | 0.4493 | 0.6784 |
| **Test Stat** | t(528) = 5.3882 | t(707) = -4.1744 |
| **p-value** | 5.37E-08 | 1.68E-05 |

**Table 5. Regression on Factors That Affect Sales Premium**

Newey West t-statistics are reported in brackets and significant level is labeled in * / ** / *** for 10% / 5% / 1% significance respectively.

| **Part A : Full Sample (Apr 2007 - Dec 2008)** | | |
|---|---|---|
| | Random Effect | Fixed Effect |
| Intercept | -0.0336 | -0.0928 |
| | (-0.238) | (-0.652) |
| Mkt | 0.0030*** | 0.0025** |
| | (3.086) | (2.100) |
| MktVol | 0.0012** | 0.0012** |
| | (1.984) | (2.081) |
| Interest | -0.0029*** | -0.0029*** |
| | (-5.454) | (-6.690) |
| Time | 0.0029 | 0.0029 |
| | (0.6474) | (0.627) |
| SHEX | -0.1235** | |
| | (-1.978) | |
| Vol | 0.0011 | 0.0012 |
| | (0.5937) | (0.856) |
| Stock | 0.0022*** | 0.0033* |
| | (3.000) | (1.927) |

Table 5 (Continued)

| **Part B: Year 2007 (Apr - Dec 2007)** | | |
|---|---|---|
| | Random Effect | Fixed Effect |
| Intercept | 0.372 | 0.4129 |
| | (1.402) | (1.386) |
| Mkt | 0.0015 | 0.0008 |
| | (0.833) | (0.354) |
| MktVol | 0.0004 | 0.0002 |
| | (0.663) | (0.333) |
| Interest | -0.0042*** | -0.0042*** |
| | (-3.687) | (-3.784) |
| Time | 0.0028 | -0.0013 |
| | (0.204) | (-0.126) |
| SHEX | -0.0666** | |
| | (-0.981) | |
| Vol | 0.0005 | -0.0022 |
| | (0.256) | (-0.654) |
| Stock | 0.0023*** | 0.0046* |
| | (2.624) | (1.928) |
| **Part C: Year 2008 (Jan - Dec 2008)** | | |
| | Random Effect | Fixed Effect |
| Intercept | -7.1119*** | -7.2731*** |
| | (-7.141) | (-6.915) |
| Mkt | 0.0318*** | 0.0312*** |
| | (7.495) | (7.098) |
| MktVol | 0.0045*** | 0.0045*** |
| | (4.023) | (4.304) |
| Interest | 0.0017* | 0.0017** |
| | (1.739) | (2.262) |
| Time | 0.2547*** | 0.2566*** |
| | (7.495) | (6.923) |
| SHEX | -0.2319** | |
| | (-2.130) | |
| Vol | 0.0005 | 0.0006 |
| | (0.1285) | (0.109) |
| Stock | 0.0022* | 0.0046 |
| | (1.937) | (1.307) |

## Table 6. Monthly Sales Premium (Estimated)

Newey West t-statistics are reported in brackets and significant level is labeled in * / ** / *** for 10% / 5% / 1% significance respectively. All the estimated monthly sales premium that are significant at 1% level have been highlighted.

| Time | Sales Premium | Standard Error | t Ratio | p-Value |
|---|---|---|---|---|
| May-07 | -0.303347 | 0.1098 | -2.761 | 0.0058 *** |
| Jun-07 | -0.466748 | 0.1019 | -4.581 | 5.11E-06 *** |
| Jul-07 | -0.190439 | 0.1313 | -1.45 | 0.1473 |
| Aug-07 | -0.0946608 | 0.1899 | -0.498 | 0.6183 |
| Sep-07 | -0.100716 | 0.2205 | -0.457 | 0.6479 |
| Oct-07 | -0.193306 | 0.2288 | -0.845 | 0.3983 |
| Nov-07 | -0.19938 | 0.1396 | -1.428 | 0.1535 |
| Dec-07 | -0.261129 | 0.1909 | -1.368 | 0.1716 |
| Jan-08 | -0.442584 | 0.1307 | -3.387 | 0.0007 *** |
| Feb-08 | -0.168673 | 0.1382 | -1.221 | 0.2224 |
| Mar-08 | -0.430131 | 0.1032 | -4.168 | 3.29E-05 *** |
| Apr-08 | -0.170451 | 0.1018 | -1.674 | 0.0944 * |
| May-08 | -0.242957 | 0.1062 | -2.288 | 0.0223 ** |
| Jun-08 | -0.892006 | 0.1575 | -5.663 | 1.85E-08 *** |
| Jul-08 | -0.253738 | 0.1502 | -1.689 | 0.0915 * |
| Aug-08 | -0.421563 | 0.1958 | -2.153 | 0.0315 ** |
| Sep-08 | -0.364324 | 0.2085 | -1.747 | 0.0809 * |
| Oct-08 | -1.03667 | 0.2649 | -3.914 | 9.58E-05 *** |
| Nov-08 | -0.0841772 | 0.244 | -0.345 | 0.7302 |
| Dec-08 | -0.274544 | 0.2442 | -1.124 | 0.2612 |

**Table 7. Robustness Test**

i. Part 1 – Fixed Effect Models

| Test 1: Common Intercept For Different Groups<br>Null Hypothesis: The groups have a common intercept | | | |
|---|---|---|---|
| | 2007 | 2008 | Full Sample |
| Test Statistic: | F(58, 464) = 1.5629 | F(58, 643) = 0.8420 | F(58, 1172) = 0.8840 |
| p-value | 0.0072 | 0.7913 | 0.7184 |
| Result | Reject | Cannot Reject | Cannot Reject |
| Test 2: Auto-correlation<br>Null Hypothesis: Errors are serially independent | | | |
| | 2007 | 2008 | Full Sample |
| Durbin - Watson | 1.9064 | 2.1922 | 2.1160 |
| Result | Cannot Reject | Cannot Reject | Cannot Reject |

ii. Part 2 – Random Effect Models

| Test 3: Heteroskedasticity - Breusch-Pagan Test<br>Null Hypothesis: Variance of the unit-specific error = 0 | | | |
|---|---|---|---|
| | 2007 | 2008 | Full Sample |
| Test Statistic: | $\chi^2(1) = 6.1255$ | $\chi^2(1) = 0.8454$ | $\chi^2(1) = 0.5698$ |
| p-value | 0.0133 | 0.3578 | 0.4503 |
| Result | Reject | Cannot Reject | Cannot Reject |
| | | | |
| Test 4: Consistency of Estimators - Hausman Test<br>Null Hypothesis: GLS estimates are consistent | | | |
| | 2007 | 2008 | Full Sample |
| Test Statistic: | $\chi^2(6) = 4.3797$ | $\chi^2(6) = 0.6128$ | $\chi^2(6) = 5.2940$ |
| p-value | 0.6254 | 0.9962 | 0.5067 |
| Result | Cannot Reject | Cannot Reject | Cannot Reject |